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Journal of the Society of Arts.

FRIDAY, SEPTEMBER 18, 1863.

NOTICE TO INSTITUTIONS.

The Programme of the Examinations for 1864 is now ready, and may be had *gratis*, on application to the Secretary of the Society of Arts.

The Papers set at the Final Examinations held in May last are also published, and may be had of the Society's publishers, Messrs. Bell and Daldy, Fleet-street, price sixpence.

ON THE FERMENTATION OF LIQUIDS AND THE IMPROVEMENT OF WINE MAKING.

By Dr. Edward Merton.

Lavoisier and other eminent chemists have directed their attention to the chemical changes produced by fermentation, but without any important practical result. The experiments that I have made have indeed proved to me, as far as the present evidence goes, that the changes are infinite in their nature and in their results.

In my opinion the subject should be examined by considering the relation of the oxygen to the fermentable liquid. The vapour of sulphur for instance has so strong an affinity for oxygen, that it will entirely remove it from a fermentable liquid, such as the must of the grape, and thus prevent the fermentation of the must. Nature in several wines produces something analogous to the action of the vapour of sulphur, and it is this which causes them to keep. However, I have succeeded in regulating the fermentation at pleasure, even to the stopping it completely, and then continuing its action without employing the vapour of sulphur, and this in three separate instances. By my process I have made from a wine of inferior quality an excellent and very alcoholic wine.

In fermentation there are at work two directly opposite forces, the one which causes, the other which moderates or arrests it. If the first is predominant, it causes the formation of lactic acid ; if, on the contrary, it is the second force which is in excess, there is neither acid nor alcohol, and you have a liquid which resembles sherbet. In the juice of the grape you have for the first agent sugar, &c., and for the second agent bitartrate of potassa, an anti-ferment of the greatest utility, because it is one of the most soluble, and is precipitated in proportion as the alcohol is produced. It is in consequence of this property that in bottles which have contained port and other wines for some time, there is found spread over the glass a crust composed of bitartrate of potassa mixed with the colouring matter of the wine.

In years when the grape does not attain to a state of complete maturity there is an excess of bitartrate of potassa, and the wine keeps well; but in years which are favourable to the ripening of the grape, the first agent is in excess, and the wine does not keep so long. In this case it will be desirable to add to the must a certain quantity of bitartrate of potassa. In boiling the malt to make beer, as it contains no agent of the second kind to restrain the fermentation, the decoction would rapidly become acid if hops were not employed as the second agent to counteract the first. The cider manufactured in Normandy, and in England in the neighbourhood of Exeter, is wanting in the first agent, and consequently resembles sherbet. When I was in Devonshire, the idea occurred to me that the alcohol in a fermentable liquid perhaps depended on the quantity of sugar combined with the must. To ascertain whether this was the case, I took a measure of 40 litres (about 8 gallons) of cider-must as sweet as syrup, and I added a kilogramme and a-half (about 3 lbs.) of sugar; some days after, on examining this mixture, I found it tasted very like vinegar. Those to whom I mentioned the result told me that I had taken the precise means used at that place for making the strongest vinegar.

Here is, probably, the explanation of the phenomenon; the addition of the sugar had made the first agent predominate, had rendered the second powerless, and had transformed, by fermentation, the cider into strong vinegar. In fact, to give a summary of the process, just as to quicken a fire we blow it, to extinguish it we deprive it of air. So in fermentation, if you wish to increase it, make use of agents capable of inducing the union of oxygen with the fermentable liquid; if, on the contrary, you wish to modify it, make use of agents which have a greater affinity for oxygen than the fermentable liquid. As in the action already mentioned of the vapour of sulphur, I call the first agent a ferment or leaven; these may also be designated by the names of oxygenising agents.

There are certain phenomena which do not admit of explanation, and in expressing these we simply express a fact; thus, when I speak of oxygenation, or of deoxygenation, I mean to say that a certain effect is produced. This is an indisputable fact, but how it happens I cannot say. A piece of zinc attached to a piece of copper, prevents the oxygenation of the latter. This is a fact which may be explained by the action of electricity, but to explain how it happens that electricity produces this effect would be very difficult. Sometimes we can unravel, to a certain point, the phenomena of nature, and there we must stop.

It is greatly to be desired that a list should be made of all the agents which can produce, retard, or stop fermentation, but at present I am not able to do this. I will quote one instance of this necessity:—I have experimented in the same way on two different beers; one beer was excellent and unexceptionable, the other was flat and weak; and during the two years that I kept it under the most favourable circumstances for exciting fermentation, it did not show the least sign of working; the two beers were manufactured with different materials—the one with glucose without animal matter, the other with gelatine without glucose. Some few substances may be mentioned as having an oxygenising and others a deoxygenising property, but they require judgment and discretion in their use. Animal matters for the most part restrain fermentation; also carbonic, lactic, and even sulphuric and citric acids, in proportions which can be neutralised at pleasure, will produce the same effect.

It is generally, though not always the case, that substances which act on colours either to bleach them or to make them lighter, also arrest and diminish fermentation. The subject is not without difficulty, because it is not easy to prove that a heterogeneous liquid contains in itself different agents. These facts, in the present state of scientific knowledge, can only be proved by observation. If we find that by a certain action, a fermentable liquid becomes acid, and that by a contrary action it does not experience this change, we have the right to say that there are two forces which act in an opposite manner, and it is only by thus making careful observations that we can hope to improve the manufacture of wines. There has been much thought and labour expended to obtain this end, by means of analysis and synthesis, but the least investigation proves beyond a doubt that these means are entirely useless.

Nature, as has been shown, has furnished us with several instances where the sugar and the acid have not been decomposed, and where mixing with the "bouquet" and the alcohol they make a most delicious wine, for instance, Frontignac; and if analysis and synthesis can tell us how it happens that in this wine the fermentation is arrested at such a point as to give it the above-named qualities, we shall be in a position to manufacture Frontignac, and this argument also applies to other celebrated wines, such as Château Lafitte, Margaux, La Rose, Burgundy, Champagne, &c. But as yet analysis and synthesis have not arrived at this result. In the meantime I have attempted to fill up the gap, by the introduction into the manufacture of wine, of ferments and anti-ferments; it would, perhaps, be lost time to enumerate all the circumstances which may provoke or restrain fermentation. I have already referred to some, and I will only mention, to avoid being misunderstood, that in spite of having said that sugar is not the only necessary agent for making an alcoholic drink, it is one of the greatest importance, and plays an important part. At the present time I cannot do better than indicate the system which ought to be followed, in endeavouring to improve the making of wine, in which, I believe, much yet remains to be done.

NEW SOURCES OF COTTON SUPPLY.

The Committee of the Cotton Supply Association, in their last report, state that, from official returns, they find that during the past year cotton was received from the following places, which sent no supplies in 1861, viz.:—Canary Islands, Ionian Islands, River Gambia, China, Hong-Kong, Victoria (Australia), Japan, Tortola, St. Lucia, Cuba, Mexico, Central America (ports on Pacific), Chili. Some of these sources have doubtless been opened by the operation of high prices, and others by the efforts of your Association. The large supplies of cotton which the American war has suspended can only be gradually obtained elsewhere after years of exertion. But in proportion as the Association, by maintaining the communications which it has established with all cotton-growing countries—by the spread of the information which it can furnish—by the supply of seed, and by the local agencies which it calls into existence to co-operate with it, shall be able to multiply the sources from which cotton can be procured, and to increase their productiveness, it will continue to abridge the present severe crisis, and to prevent its recurrence.

The Committee have given much time and attention to the consideration of the best machines for cleaning cotton. The saw-gin, so generally employed on the shorter American staples, is extremely prejudicial to the long stapled cotton grown in other countries—instances of injury have been brought before the Committee causing a depreciation of from 20 to 30 per cent. in value. There is still great room for improvement in the construction of cleaning apparatus, and the Committee would specially direct the attention of machinists to the necessity existing for a gin of universal application, which shall turn out as much cotton as the saw, with that freedom from injury which is secured by the roller gin. The question of packing presses is engaging the attention of the best makers of the country, and the Committee desire especially to point out to the makers of agricultural implements the great demand for those of the best construction which has arisen in all cotton-growing countries. The Association obtained from the United States a complete set of the most approved agricultural implements, which, as models, are at the service of all makers who may choose to avail themselves of them. The Agricultural Exhibitions in Calcutta and Smyrna, in January, 1864, will be occasions of which makers would do well to take advantage.

BRITISH ASSOCIATION, NEWCASTLE-ON-TYNE, 1863.

Chemical Manufactures on the Tyne.

Mr. J. C. Stevenson read the following paper on "Chemical Manufactures on the Tyne:"—

Salt.—Salt works were formerly very numerous in this district, establishments having been formed at Howdon Pans, Hartley Pans, Jarrow, North and South Shields, and other localities. This trade was carried on by several of the most wealthy families in the neighbourhood in the beginning of the last century, and about 200 pans were employed in producing salt, which was extracted from sea-water and brine springs. Shields salt was the most celebrated salt in the kingdom, and was produced in such quantities at South Shields as to give a character and even a nomenclature to this town, which to this day is divided into East Pan and West Pan Wards. The remains of a large hill are still to be seen, formed from the ash of the salt pans. After a time these ashes took fire, and Mr. R. W. Swinburne—to whom we are indebted for this information—states that the Chapter of Durham are in possession of a picture, representing the burning hills at South Shields. The production of salt from sea water in this locality has given place to that obtained from the brine springs and rock salt of Cheshire, and illustrates what great changes take place in altering the *locales* of manufactures. A considerable quantity of white salt is still made on the Tyne from sea water, in which rock salt from Cheshire and Ireland is dissolved, in order to diminish the cost of evaporation. Two improvements have been successfully introduced in making white salt, which have the saving of fuel as their object. Mr. Wilkinson employs the waste heat of coke ovens for this purpose; and Mr. Fryar dries whitening with the heat which escapes from his salt pans.

Alkali (for this and the last century).—Two gentlemen, Mr. W. Losh and Mr. Thomas Doubleday, were engaged, unknown to each other, with a series of experiments on the best plan of converting common salt into carbonate of soda. Each of these chemists appear to have used very similar processes; and when the late Lord Dundonald came to reside in the neighbourhood, he was soon on intimate terms with both parties. Both Mr. Losh and Mr. Doubleday tried numerous plans at his lordship's suggestion; but after spending upwards of £1,000, Mr. Doubleday would seem to have tired of making an outlay which promised little or no result. The first plan tried was to effect the decomposition of common salt by means of oxide of lead, and to carbonate the caustic soda, while the insoluble chloride of lead was heated to form a yellow pigment, long known as Turner's yellow. Another process consisted in decomposing common salt by sulphate of iron. The resulting sulphate of soda was fluxed with coal, and the sulphide of sodium which was formed was carbonated with sawdust. This plan was also worked some time afterwards at an alkali manufactory situated near Blyth. Another process tried was founded on the neutral decomposition of common salt and sulphate of potash. This operation was regularly carried on by Mr. Losh and Mr. Doubleday, whenever the price of the two potash salts allowed a profit being made, and the chloride of potassium was as regularly sold to the Yorkshire alum makers. Mr. Losh resided in Paris in 1791, where he acquired a knowledge of chemistry, and soon after his return home a company was formed to manufacture soda at Walker. The original partners were Lords Dundas and Dundonald, Messrs. Aubany and John Surtees, and John and William Losh. They obtained their salt from a brine spring found in a coal pit at Walker, and the heavy duty upon salt at that date, which was £36 per ton, was avoided by evaporating together a concentrated solution of the brine spring and sulphuric acid, thus forming sulphate of soda, and avoiding making salt. Another plan adopted by Mr. Losh to avoid the duty was to add ground coke or ashes to the concentrating salt pan before the salt was formed, and use it in this damaged condition for the manufacture of sulphate of soda. This was about the year 1796; Messrs. Doubleday and Easterby, in 1808, commenced making sulphate of soda be decomposing the waste salts from the soap-boilers, which consisted chiefly of common salt and some sulphate of soda. Their chief supply was obtained from the Messrs. Jamieson and other soap-boilers at Leith. They purchased their sulphuric acid at first, but between 1809 and 1810, they got the plans of chambers from Messrs. Tennants, of Glasgow, and erected the first chamber on the Tyne, at Rill Quay. They imported the first cargo of sulphur from Sicily about the same time, and its arrival in the river excited great attention. At first the Government returned them the import duty on the sulphur which was used in making acid, and the present Mr. Doubleday remembers having received at the end of the year as much as £1,500. This, however, only lasted three or four years, when the duty was repealed. This firm, then trading under the name of Doubleday and Easterby, also erected the first platina retort for making rectified vitriol, and which cost them £700, and before long they had three retorts in operation. The alkali which they made was used in the crude form in the manufacture of soap, in which they were also engaged. In 1816, after the conclusion of peace, Mr. Losh returned to Paris, where he learned the details of the present plan of decomposing sulphate of soda, which he immediately introduced in his works at Walker, and thus may be said to have been the father of the modern alkali trade in this country. Mr. Doubleday gave the plans of his chamber, furnaces, &c., to the Messrs. Cookson, when they commenced their alkali works at South Shields, and these gentlemen made Wright (Mr. Doubleday's foreman) a present of a silver tea service, in consideration of the services he had rendered. This trade has been developed in an extraordinary manner in this locality, where about 47 per cent. of the whole produce of the United Kingdom is now manufactured. The peculiar advantages of the district are also being recognised by the fact that the celebrated firm of Messrs. Tennant have purchased land with the intention of removing the greater part of their works from Glasgow to the banks of the Tyne. Charles Cooper, an overman at Walker Colliery, informs us that he was employed by Mr. Losh in 1798, and that crystals of soda were then manufactured and sold by Mr. Losh. The salt obtained from the brine spring on the premises was evaporated in small lead pans, and was afterwards decomposed by litharge. The soda so produced was crystallised in small lead cones, and when it had stood sufficiently long to crystallise, the cones were turned upside down to run off the mother liquor. The crystallising process was then only carried on in the winter months. C. Hunter, Esq., of Walker, further informs us that in 1816 he sold about half a ton of soda for Mr. Losh, to a Mr. Anderson, of Whitby, at £60 per ton. The following details will embrace a brief account of the source of the raw materials, and the various improvements which have been recently introduced.

Source of Sulphur.—Until within the last few years Sicilian sulphur was almost exclusively employed in this district for the manufacture of sulphuric acid—the pyrites from Wicklow being the only other source of supply. This latter, however, was not sufficiently abundant to render the manufacturer independent of the great fluctuations which have recently taken place in the price of sulphur, on account of the demand consequent on the vine disease. During the last few years the following additional sources of supply have become available. 1st. Belgian, 2nd. Norwegian, 3rd. Spanish or Portuguese, 4th. Italian, 5th. Westphalian pyrites. 1. The Belgian pyrites has the advantage of being shipped at Antwerp at a moderate freight to the Tyne. It is a very hard, compact material, containing about 50 per cent. of sulphur, and therefore nearly approaches a pure bi-sulphuret of iron. The burnt residue from one manufactory on the Tyne (the Walker Alkali Works), after being roasted in a lime kiln to burn off the small remaining portion of sulphur, is regularly used as an iron ore at the adjoining iron works. It contains no copper, and from 3 to 5 per cent. of arsenic. 2. The Norwegian pyrites is shipped at Levanger. It contains 44 per cent. of sulphur, is easily broken, and does not readily flux in the kiln. The quantity of copper it contains being less than 10 per cent., the burned residue cannot be profitably smelted for copper. 3. The most extensively used pyrites is shipped from Huelva, in Spain, and Pomeron, in Portugal. The mines are situated on each side of the boundary between the two countries. They were most extensively worked in ancient times, but their recent development has arisen from the use of the ore as a source of sulphur. Containing only 2 to 4 per cent. of copper, it was unable to compete with the richer ores which from time to time became available in different parts of the world, but the mining is now rendered profitable by the value of the sulphur being realisable as well as that of the copper. The per-centage of sulphur varies from 46 to 50. The practical difficulty in burning this ore, namely, its great fusibility at the point where the combustion of the sulphur gives rise to considerable heat, has been overcome by the adoption of kilns, first used in Lancashire, in which the area of the surface is large in proportion to the weight of the charged pyrites. The use of cupreous pyrites has led to the introduction of the manufacture of copper on the Tyne, which will this year amount to between 700 and 800 tons. The ordinary process of smelting is employed—but the moist method is also being tried; the advantage being that, by this method, all the ingredients of the mineral are utilised, the oxide of iron making an ore of similar quality to hematite. The smelting process, however, is still preferred in the large manufactories. In 1860, several cargoes of an ore containing free sulphur imbedded in gypsum were imported from the Island of Milo, in the Archipelago. From the small quantity of sulphur contained in it (19 up to 24 per cent.) there was great difficulty found in burning it, except the large masses. Subjoined is an analysis of one parcel of it:—Sulphur, 24·00; gypsum, 62·20; sand, &c., 6·00; water, 7·00. Still more recently, Professor Ansted has discovered a deposit of free sulphur in Corfu, of which he has been kind enough to forward a sample, but we believe it has not been used in commerce. When sulphuric acid is wanted quite free from arsenic, Sicilian sulphur must be used. So largely has pyrites displaced sulphur in the production of sulphuric acid, that in 1862 only 2,030 tons of sulphur were consumed, against 72,800 tons of pyrites; and, reckoning the above quantity of sulphur as equivalent to 4,500 tons, it appears that 77,300 tons of pyrites are annually used for the manufacture of sulphuric acid, along with 2,500 tons of nitrate of soda. Assuming a produce of 120 per cent. on the pyrites, this is equal to a production of 92,760 tons of sulphuric acid, calculated as concentrated. This quantity of sulphuric acid is nearly all consumed where it is made, for the manufacture of other chemicals, such as soda and manures, the quantity sold being 64·40 tons, but this might be more correctly described as consumed in other works, for the quantity sent to a distance is very small. Four-fifths of the sulphuric acid is used for the decomposition of common salt.

Salt and the Alkali Trade.—The ordinary Cheshire salt is almost exclusively used for the manufacture of alkali, the exception being in one manufactory, where the waste heat of coke ovens is utilised in evaporating the liquors formed by dissolving rock salt. The anciently extensive salt works of Shields are now represented only by one or two comparatively small manufactories of salt, intended entirely for domestic use. Nearly all the salt used in the alkali works is carried by canal to Hull, Goole, or Grimsby, whence it is brought to the Tyne at a nominal freight, generally by foreign vessels, that take it as ballast when coming to the Tyne for an outward cargo of coals. This is the only practical result of the repeal of that portion of the navigation laws that prevented foreign ships carrying cargoes coastwise. The annual decomposition of common salt in the district is 90,000 tons, requiring 73,800 tons of sulphuric acid, and producing 100,000 tons of dry sulphate of soda. The whole of this quantity is used in the manufacture of alkali. A few hundred tons are consumed in the glass manufacture, but are left out of this account, as no account has been taken of the sulphate of soda made from the nitrate of soda in the sulphuric acid process. The alkali is produced in the four forms of —1. Alkali or soda ash, 43,500 tons; 2. Crystals of soda, 51,300 tons; 3. Bi-carbonate of soda, 7,450 tons; 4. Caustic soda, 580 tons. The manufacture is so well understood, that only local peculiarities and recent improvements need be noted.

ALKALI.—All the Tyne soda ash is fully carbonated, sawdust being generally used in the furnace for this purpose, so that it contains merely a trace of hydrate of soda. The greater part of it is also refined by dissolving, settling, evaporating, and calcining, producing thus an article of great whiteness and purity.

CAUSTIC SODA.—This manufacture is as yet quite in its infancy in this district. In Lancashire, very large quantities are made from the "red liquors" which drain from the soda salts. These liquors always contain caustic soda, sulphuret of sodium, and common salt. In Lancashire, where a hard limestone is used for balling, the per-centage of caustic soda is large, while the sulphuret exists in small proportion, and it is easily oxydized. It would seem that the London chalk which is used here produces a lime, chemically much less energetic, forming less caustic soda, and holding sulphur more loosely in combination. Consequently the Tyne red liquors require a very large quantity of nitrate for their oxydation, and yield so little caustic that this process has been abandoned in favour of the well-known method of boiling a weak solution of alkali with lime. This has the advantage, however, of producing a richer and very pure article, sometimes as strong as 74 per cent.

The improvements (besides such as have been already noticed) which have been introduced into the alkali trade since the last meeting of the British Association in Newcastle, may be divided into those which have been generally adopted, and the special improvements of individual manufactures. 1st. Economy of labour has been attained by using larger furnaces in which a workman can manipulate a larger charge with less toil, and by various other appliances purely mechanical. 2nd. Economy of fuel has been largely attained by the application of the waste heat and flame from the ball furnaces, to the surface evaporation of the tank or black ash liquor. Formerly this was evaporated in hemispherical cast-iron pans, each with a fire below. 3rd. Economy of water and fuel by the adoption of the circulating tanks for lixiviating balls, first introduced at Glasgow, by the late Mr. Charles Tennant Dunlope. They are so arranged as regards their connections with one another, that water runs into the tank which has been most nearly exhausted, and liquor of full strength runs off the tank which has been most recently filled. The balls are always under the surface of the liquor and thus escape the partial decomposition and consequent formation of sulphurate which resulted from the balls being subjected to successive washings and drainings off. 4th. Use of cast-iron decomposing pans. 5th. Gay-Lussac's process for recovering and using again the waste nitrous acid in the manufacture of sulphuric acid, has been adopted by several manufacturers; others consider that the expense of the erections, and of working the process, may be better applied in providing an additional amount of space in the leaden chambers. Special Improvements. —1st. Revolving ball furnaces, invented by Messrs. Elliott and Russel, of St. Helen's, and used in the Jarrow Chemical Works. See Jury Report by Dr. Hoffman. 2nd. In the Walker Alkali Works the waste gas (carbonic oxide) from the blast furnaces of the adjoining iron works is conveyed by flues to the evaporating and calcining furnaces. The advantage obtained is not only economy of fuel, but a hot flame free from smoke and dust, and dispensing with the stoker's labour and tools. For easily regulating the bottom heat of the cast-iron pan in which salt is decomposed, it is found very useful. The carbonic oxide is, however, found not to burn very well in the presence of muriatic acid gas.

HYPOSULPHITE OF SODA.—The manufacture of hyposulphite of soda has largely increased of late years, and we believe in 1838 it was not made at all upon the Tyne. In 1854, the produce only amounted to 50 tons a year. It has gradually risen to 400 tons per annum. In addition to being used in photography, it is largely employed as an "anti-chlor" in papermaking, and from the Tyne the markets of Europe and America are chiefly supplied. In 1852, Mr. W. S. Losh obtained a patent for the manufacture of hyposulphite of soda from soda waste, which has been the means of greatly lessening the price, and consequently extending its application in the arts. On account of its greater stability, hyposulphite of soda has nearly superseded the use of the older salt of sulphite of soda as an "anti-chlor," the latter being chiefly confined to sugar refineries as a de-oxidizer. Dr. Jullion has recently obtained a patent for the production of hyposulphite of lime, to be used as an "anti-chlor," but it has not yet been introduced in commerce, the apparatus for its manufacture in course of erection at the Jarrow Chemical Works being not yet completed.

HYDROCHLORIC ACID.—In the decomposition of common salt vast quantities of hydro-chloric acid are necessarily produced, and it is an important question for chemical manufacturers to apply the best means for its condensation. Since the visit of the Association in 1838, few branches of manufacture have received more attention, and there are few in which greater improvements have been effected than in condensing muriatic acid gas; and this has arisen not only on account of the necessity of preventing injury to agriculture, so that heavy claims for damage might be avoided; but also in consequence of the commercial value attached to hydrochloric acid in the production of bleaching powder, bi-carbonate of soda, oxy-chloride of lead, and other products. The methods generally adopted in condensing are well-known, and we shall only allude to some of the improvements practically applied. The drying furnace usually used is what is called an "open furnace," to which the heat of the fire is directly applied, and we believe that the greatest difficulties in the way of a perfect condensation, in former times, arose with the gases from this furnace. The heat required to drive off the gas from the crude sulphate of soda is very great, and when the gases arrived in the condensers it was found difficult to absorb them, even when a very large quantity of water was used, and the muriatic acid which was thus produced was of so low a strength that it was commercially almost useless. In former years also, the draught through the condensers was always obtained by a connection with a high chimney, but in some of the works this plan is now abandoned; and the whole of the vapour or gas which escapes passes through a 12-inch pipe always open to view. At present these gases are conducted through long flues or pipes and cooling shafts, and on entering the foot of the condensers the heat is reduced to about 140° Fahr., at which point the gases easily condense, and a strong acid is at the same time obtained. A rather different method has been pursued for some time at Messrs. Allhusen and Sons' works. Instead of the heat from the fire being conducted directly on to the drying materials in the furnace, which is generally done, a "close furnace" is used, in which the flame from the fire passes over a brick arch and under the bed of the furnace, and not in immediate contact with the materials; this furnace has no connection with a chimney for its draught, and the gases from both the pan and dryer pass into one condenser. The hydrochloric acid passes off from the furnace unmixed with the smoke from the fire, and at a lower temperature than by the ordinary method; and is consequently more easily condensed, and obviates the necessity of long flues or cooling shafts. Messrs. C. Allhusen and Sons have given us the following results of some recent experiments with this class of furnace. The charge of salt usually used was 8 cwt., the moisture varied from 6 to 9 per cent., and the sulphate of soda contained from 1·75 to 2·25 per cent. of undecomposed salt.

	Salt undecomposed.	Moisture per cent.	Theoretic Weight of Acid.	Acid obtained.	Loss per cent.
1st Experiment ...	1·75	7·0	502.0	495·06	1·4
2nd " ...	1·70	7·0	498·0	489·00	1·8
3rd " ...	2·25	7·0	498·0	484·08	2·6
4th " ...	1·80	7·0	498·0	490·04	1·6
5th " ...	1·70	7·0	498·0	485·00	2·6

Average loss per cent. ...... 2·0

As a further instance of the care that is now bestowed in condensing, we append also the result of some recent experiments conducted at the Walker Alkali Works, to ascertain the actual quantity of muriatic water condensed. The daily produce was conducted into large stone cisterns prepared for the purpose, and the strength, depth, &c., was carefully ascertained. The salt used was also tested daily for moisture and impurities, such as sulphates, sand, &c. The former was found to average 6 per cent., and the latter 1 per cent., during six months' trial, thus leaving 92·5 per cent. Na. Cl. = 57·7 H. Cl. in 100 parts of salt used.

The crude sulphate of soda produced was also daily tested for common salt left undecomposed, which is deducted below:—

		H. Cl.		Test of Sulphate.
January...	100 Parts of Salt gave ...	58·3	......	2·59
February .	" "	53·0	......	2·24
March ...	" "	54·2	......	2·26
April	" "	57·4	......	2·14
May	" "	58·4	......	2·98
June	" "	53·9	......	2·12
	Average H. Cl.	55·8	......	2·45
	H. Cl. left in Sulphate of Soda	1·52		
		57·32		
	Loss per cent.	0·38		
		57·70		

A patent was obtained in 1860 for the use of the weak acids in the place of water in condensing, which has been successfully carried out in the above works, and it will thus be seen that the whole of the acid produced was obtained and calculated without difficulty. Muriatic acid is not entirely free from impurities, and on account of its containing arsenic, iron, sulphuric acid, &c., it is not applicable to all purposes. The total quantity of hydrochloric acid produced is about 180,000 tons per annum.

Manganese.—Manganese is imported from Germany and Spain, but it is chiefly from the latter country that the richest ores are now obtained, which are found in hills consisting of schistose rock, which sometimes rise to a height of 800 feet from the level of the plain; but it is also found in "pockets," and, in the latter case, it is quarried by picks, and occasionally gunpowder is used. The quality of the ore varies from 50 to 90 per cent. per oxide, and to obtain the richer ore men and boys are employed to break and sort it, which is then put into sacks and carried a distance of 20 to 35 miles, on mules' backs, to the ports of shipment in the Mediterranean. The richest ores are obtained at Calanas, in the province of Huelva, 30 miles north of the ancient Roman fishing town of Huelva. We are indebted to Mr. S. F. Gething for this information, who also informs us that he imported to the Tyne in 1857 the first cargo of Spanish manganese. Manganese ore frequently contains peroxide of iron, copper, cobalt, titanium, &c., but no means has hitherto been taken to separate them. Manganese is used in the manufacture of glass, iron, and of bleaching powder; and for the latter it is imported to the extent of 14,400 tons annually. Several patents have been taken out for the recovery of the manganese from the waste chloride of manganese solutions, but generally with indifferent success. The most successful, however, is the process of the late Mr. Charles Dunlop, of Glasgow, in which the manganese is precipitated as a carbonate, and finally oxidised. This patent has, we believe, been successfully worked at St. Rollo, in Glasgow, and has, to some extent, superseded the use of native manganese. Still more recently a patent has been obtained by Mr. Clapham for the separation of the free hydrochloric acid contained in the waste manganese solutions, and for its application in the manufacture of bleaching powder.

French Limestone, locally called Cliff, is imported as ballast from the Seine, and also from the coast of France, to the extent of about 14,000 tons annually. It forms part of the upper chalk bed in the secondary deposits, and is nearly pure carbonate of lime; and although very like chalk in its appearance, differs from it to some extent in being compact, harder, and less susceptible of retaining water. It is always used in this locality in preference to other limestones in making bleaching powder.

Bleaching Powder.—Since 1838, the method pursued in the manufacture of bleaching powder has entirely changed, and the quantity made has far more than doubled. At that time it was made by the decomposition of manganese and common salt with sulphuric acid, which was a rather costly process, and the price was about £28 per ton. It is now manufactured from what was at one time the waste muriatic acid referred to above, and the price has been reduced to one-third. During the last few years the demand for bleaching powder has been increased, partly on account of the extensive use of esparto grass from Spain in the manufacture of paper, which has been found to require a large quantity of chemicals to bleach it, and nearly all the Spanish grass imported to this country is shipped to the Tyne. The quantity of bleaching powder now made is 11,200 tons annually.

Soap.—The first soapery in this locality was begun by Messrs. Lamb and Waldie, about the year 1770, at the Westgate, whence it was removed to the Close. The works were purchased by Mr. Thomas Doubleday, in 1775, and continued under the firm of Doubleday and Easterby until the year 1841. Other manufactories were built in Sandgate and at the Ouseburn, all of which have been abandoned. Very little hard soap was made until the end of the last century; what was used was Castile soap. Up to 1770 soft soap was chiefly used for both domestic and manufacturing purposes. The chief improvements introduced have been the use of Palm oil, bleached by Watts' process, and the manufacture of the ley by boiling the alkali with the lime instead of the so-called "cold process." The total quantity now manufactured exceeds 6,000 tons per annum. The prices of various materials at the present time are as follows:—Tallow, first sort, T. C., 43s. 6d.; fine American resin, 36s. to 39s.; best yellow soap, 33s. to 35s.; best mottled soap, 33s. per cwt.

Prussiate of Potash.—The first attempt to manufacture any compound of cyanogen in this district was made in the beginning of the last century, by a Jew, in Oakwellgate, in Gateshead. He afterwards removed his apparatus to Corbridge, but failing in producing a saleable article, he discontinued the operation, which was taken up by a Mr. Simpson, who ultimately succeeded in perfecting the process in works erected at Elswick. Mr. Simpson manufactured Prussian and other kinds of blue colours; and at his death the manufacture was removed to Heworth, where the Messrs. Bramwell have carried on the works since 1758. Prussian blue was the only form in which the cyanogen was produced, from which prussiate of potash was afterwards manufactured. This salt was not known in commerce in a crystalised form, however, till about the year 1825, when the price was 5s. per lb., which has now fallen to 2s. 11½d. Mr. Bramwell has introduced various improvements in the manufacture of this salt, employing close pots, in which the fused materials are worked by machinery, and in substituting sulphate of potash for the more expensive potashes, but notwithstanding the application of every chemical and mechanical appliance, and the low prices at which the prussiate of potash is sold, the demand has fallen off, and at present only two tons of yellow prussiate and three quarters of a ton of red prussiate are now manufactured weekly. The decline in this trade has arisen partly from the American civil war and partly from the introduction of the analine colours. The celebrated attempt, in 1841, to produce cyanogen from the nitrogen of the air, was made at these works, and although the efforts of Mr. Bramwell and his friends were perfectly successful in a chemical point of view, these gentlemen were induced to abandon the process as a manufacturing operation.

Alum.—The first alum works established in England were erected at Guisbro', in 1460, by Sir Thomas Challoner, who brought over a workman from France to carry out the then secret process, the monopoly of this trade being in the hands of the Pope. The works were subsequently decreed to be a royal mine, and passed into the possession of the crown. They were afterwards farmed to Sir Paul Pindar, at a rental of £15,000 per annum. He employed about 800 persons, and made large profits, his monopoly enabling him to keep up the price to £26 per ton. The Long Parliament restored the mines to the original owners, and, at the Restoration, not less than five works were in operation. The process is well known, but potash alum (formerly the only alum made) is now produced at the Loftus Works, all the other manufacturers employing the cheaper sulphate of ammonia. From the mother liquors large quantities of an impure sulphate of magnesia are obtained, which are partly refined and partly consumed as a manure, mixed with other substances. Alum and sulphate of alumina are also made from sulphuric acid and clay, or shale, but the quantities are not very large. The quantities produced annually are as follows:—Alum, &c., 4,000 tons; rough Epsoms, 1,800 tons. Some improvements in the details have been introduced to economise labour and save materials. The precipitation of the iron from aluminous liquors by means of prussiate of iron was first employed here by Messrs. Lee and Co., and the Guisbro' Alum Company have introduced an aluminous cake, containing sulphate of magnesia, which has been found to answer very well in dying certain colours, as browns, blacks, &c., and in the manufacture of all kinds of coarse paper.

Epsom Salts.—The abundant supply of Dolomite on the coast of Marsden, three miles south of the Tyne, and at other places in the county of Durham, has for many years sustained the manufacture of sulphate of magnesia on the Tyne. The mineral is a tolerably pure double carbonate of lime and magnesia, containing about 21 per cent. of magnesia. Analysis by Mr. Clapham.—Silica 10·00; alumina 1·60; oxide iron 0·50; carb. mag. 35·33; carb. lime 52·50. The process formerly employed was to calcine the limestone, and wash it repeatedly with water, by which, however, the lime is only imperfectly removed. the residue being dissolved in acid and crystallised. The principal source of sulphate of magnesia for many years past has been the rough Epsoms, obtained from the residual mother liquors of the Yorkshire Alum Works. In these salts protocide of iron replaces a variable proportion of magnesia, forming a double salt and containing also free sulphuric acid.

Analysis of Rough Epsom Salts, by Dr. Richardson:—Sulphuric acid 32·26; magnesia 15·35; protoxide of iron 1·73; oxides of nickel and cobalt 0·12; lime 0·09; alumina 1·33; potash 0·83; water 48·29. Formerly these salts were mixed with washed magnesia lime, and then calcined, in order to peroxidise the iron. It is found, however (as first suggested by Dr. Richardson), that calcination is unnecessary when the solution is sufficiently diluted, and when space is provided in the precipitating tank for the bulky precipitate of protoxide of iron, which is formed by the gradual addition of magnesian lime. This is probably the only chemical manufacture of the district, with the exception of prussiate of potash, which has greatly fallen off in extent, a more rational system of medicine having diminished the use of purgatives, and reduced the demand for Epsom salts to about one-third of what it was 20 years ago. The annual production is still 1,500 tons, two-thirds of which are made from the rough salts.

Carbonate of Magnesia.—This compound has long been produced in this district, where it was formerly, and is still to a limited extent, manufactured from the mother liquors of the salt pans, known as bittern, to which carbonate of soda is added to precipitate the magnesia in the form of carbonate. This old process has been largely superseded by the elegant process of the late Mr. H. L. Pattinson, which consists in submitting calcined magnesian limestone to the action of carbonic acid and water, under pressure. The magnesia dissolves out as bi-carbonate of magnesia, from which the neutral carbonate of magnesia is precipitated by the application of heat. The quantity manufactured is said to be about 250 tons per annum.

Superphosphate of Lime.—The manufacture of this article was commenced at Blaydon in 1844, by Dr. Richardson, soon after the publication of Liebig's celebrated report on agricultural chemistry. Various materials are employed as the source of phosphate of lime, viz., bones, bone ashes from South America, exhausted animal charcoal from the sugar refineries, coprolites from Suffolk and Cambridgeshire, phosphate from Spain, Sombrero guano, &c. Improvements have been introduced in the manner of mixing the acid with these substances, in drying the superphate, and in the riddling of the superphosphate. The quantity produced amounts to between 1,500 and 1,600 tons per annum.

Peal Hardening.—This article has only recently been manufactured here, and its introduction is due to Dr. Jullion, who has applied it to the hardening of paper. It is produced by precipitating hydrated sulphate of lime from a perfectly pure solution of chloride of calcium, by means of sulphuric acid. Great care is taken in its preparation, and it is being generally introduced among the manufactures of paper. The quantity made is said to be about 2,000 tons per annum.

Sulphate of Iron.—The first manufactory for the production of green copperas in England, was founded about the year 1579, when one Matthew Falconer, a Brabanter, "did try and draw very good brimstone and copperas out of certain stones, gathered in great plenty on the shore, near unto Minster, in the Isle of Sheppy." Mr. Thomas Delaval commenced to manufacture copperas at Hartley, about the year 1748, but he subsequently sold the manufactory to his brother, Lord Delaval, and by an Act of Parliament, 11th of George the III., in 1771, power was given to Sir Francis Blake Delaval, to grant to Sir John Hussey Delaval, in fee simple, all the copperas works, then and there existing, which may enable us to form some idea of the importance then attached to this manufacture. The late Mr. Barnes and Alderman Forster erected the the first copperas works on the Tyne, at Walker, in 1798, which are still in operation. The quantity at present manufactured is about 2,000 tons per annum, and the process is still the same, but Mr. Thomas Barnes has applied the refuse crystals to a novel purpose. This refuse was, and is, generally thrown away, but Mr. Barnes uses it as a manure on his farm, on the thin soil which lies on the magnesian limestone. He finds that the depth of the soil is gradually increasing by the disintegration of the rock, and that the more he uses, the more satisfactory are the results. The beneficial effort of the copperas is doubtless partly due to the natural decomposition of the carbonate of lime with the sulphate of iron, and partly to the action of the peroxide of iron on the organic matter of the soil, while being constantly renovated, a supply of oxygen is provided in a solid form, by this hydrated oxide of iron.

Venetian Red.—The manufacture of this article has long been carried on in this neighbourhood, and is noticed here, as it is so closely related to green copperas. It is made by calcining a mixture of copperas and some native hydrated oxide of iron, chalk, and gypsum. The calcined mass is levigated and dried. About 4,000 tons per annum are manufactured on the Tyne, and the price varies from £4 10s. to £5 per ton.

Sulphate of Copper.—This salt was formerly produced by roasting old copper in a reverberatory furnace, and then dissolving the oxide in sulphuric acid, but it is now obtained in carrying out Longmaid's process for decomposing common salt by means of cupreous pyrites. The quantity made is about 100 tons per annum, which is all produced at the works of Messrs. J. and W. Allen.

Resin Size.—This article is manufactured according to a patent obtained by Mr. W. S. Losh, and is intended to produce a size suitable for paper makers, and to supersede the old size in ordinary use, which consists of alum, resin, and soda ash. Its manufacture has, however, been only partially developed, and not more than 100 tons yearly is produced, but a new and cheap size, which can be prepared ready for the use of the paper trade, is, we think a step in the right direction, and the theory of the sizing of paper is a field still open to chemists.

Lamp Black.—The manufacture of lamp black, we believe, is peculiar to this locality, and it is produced from bituminous coals. These coals are slowly burnt, at a dull heat, and with as small a supply of air as possible. The smoke is conducted into brick chambers, into which a jet of steam or water is passed to assist in the better formation of the lamp black. The quantity made is about 1,200 tons annually.

Grease.—This is another local product, and is made to the extent of 2,800 tons annually. It is chiefly produced from the distillation of resin, and in a locality like Newcastle, surrounded by extensive collieries and works, the consumption is considerable. Since the American war the price has been much affected, and we are told has advanced from £8 or £9 per ton to £22 per ton.

QUANTITIES AND PRICES.

Raw Materials.	Tons.	Price.			Value.	
		£	s.	d.	£	s.
Sulphur (included as Pyrites).	72,800	0	10	0	109,200	0
(Copper value not included.)						
Salt	90,000	0	15	0	67,500	0
Nitrate of soda	2,500	14	15	0	36,875	0
Chalk	144,000	0	2	6	18,000	0
Coals	323,000	0	3	9	60,562	10
Manganese	11,400	4	0	0	45,600	0
Rough Epsom salts	1,500	2	5	0	3,375	0
Magnesian limestone	700	0	3	6	122	10
French limestone	14,000	0	4	6	3,150	0
Resin	......				....	
Tallow	......				....	
Finished Products.						
Alkali	43,500	8	10	0	369,750	0
Crystals of soda	51,300	4	15	0	243,675	0
Bi-carbonate of soda	7,450	12	0	0	89,400	0
Caustic soda	580	18	0	0	10,440	0
Hyposulphite of soda	400	25	0	0	10,000	0
Oil of vitriol	6,440	6	0	0	38,640	0
Epsom salts	1,500	7	5	0	10,875	0
Hydrochloric acid	180,000				....	
Sulphuric acid used in the manufacture of soda	86,320				....	
Bleaching powder	11,200	9	0	0	100,800	0
Soap	6,000	34	0	0	204,000	0
Yellow prussiate of potash	105	0	1	0 per lb.	11,760	0
Red do.	40	0	2	6 per lb.	11,200	0
Alum	4,000	7	0	0	28,000	0
Carbonate of magnesia	250	30	0	0	7,500	0
Superphosphate of lime	15,000	5	0	0	75,000	0
Pearl hardening	2,000	10	0	0	20,000	0
Sulphate of iron	2,000	3	0	0	6,000	0
Venetian red	4,000	5	0	0	20,000	0
Sulphate of copper	100	35	0	0	3,500	0
Resin size	100	7	0	0	700	0
Lamp black	1,200	7	0	0	8,400	0
Grease	2,800	8	0	0	22,400	0
Cements	12,000	2	0	0	24,000	0

Pyrites.

Mr. John Pattinson gave an abstract of a paper "On the various kinds of Pyrites used on the Tyne and Neighbourhood, in the Manufacture of Sulphuric Acid." Iron pyrites, or sulphate of iron, he said, had been used on the Tyne as a source of sulphur in the manufacture of sulphuric acid since about the year 1840. In this locality a few hundreds of tons of sulphur per annum are now only made into sulphuric acid, which is concentrated and sold for special purposes, for which the acid from pyrites is unfitted, owing to its containing a small quantity of arsenic; whilst about 75,000 tons of pyrites are annually consumed, containing on an average 34,000 tons of sulphur, and representing a value of about £110,000. The remainder of the paper was chiefly taken up with details respecting the amount of pyrites used on the Tyne and an analysis of the substance. Cleveland pyrites is found between the beds of ironstone of the Cleveland District, in Yorkshire, and is only used at one large sulphuric acid manufactory, situate at Middlesbro'. The deposit varies from 6 to 12 inches in thickness, and consists of concretions of oolitic particles of pyrites, mixed with ironstone, which crumble to pieces on exposure to the air. On an average, it only contains about 25 per cent. of sulphur. Of the "coal brasses" variety, from 6,000 to 8,000 tons are used on the Tyne per annum. It is found in the collieries of the district, associated with the coal. Besides iron pyrites and coal, this substance often contains variable quantities of carbonate of lime and oxide of iron. What the future of the pyrites trade may be it is impossible to foresee, but this mineral exists in such inexhaustible abundance, that its use in the manufacture of sulphuric acid is not likely to be superseded by sulphur, unless new and cheaper sources of the latter are discovered.

Mr. Spence stated the fact that at the present moment in Swansea, as much sulphur was being thrown off in the form of sulphurous acid gas as would make all the sulphurous acid gas used in our immense chemical manufactories. His own calculation was that they were throwing into the atmosphere there a quantity equivalent to about 4,500 tons of sulphuric acid per week. Hitherto it had been impossible to use that in the manufacture of sulphuric acid. At least, there was no plan that had been generally adopted that could be made useful. He (Mr. Spence), however, had recently devised a furnace by which he was using pyrites, and if it were adopted by the Swansea smelters, they could manufacture all the sulphuric acid at actually almost no cost. The subject was worthy of consideration.

EXAMINATION PAPERS, 1863.

(Concluded from page 699.)

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in May:—

FREE-HAND DRAWING.

THREE HOURS ALLOWED.

Make a drawing in outline of the cask and wheelbarrow which is in the room, and indicate the strong points of the shadows as they appear to you.

Draw, from recollection, a branch of a vine with leaves and fruit.

Make an enlarged outline, not less than eight inches in length, from the Queen's head on the new bronze coinage.

Make an original design, either for ornament or in figure, the subject given being, a parasite.

Candidates are not expected to attempt all the subjects given in this paper.

Directions for the Local Boards.

Put a thirty gallon cask on a wheelbarrow, and place it in the room before the candidates in free-hand drawing.

Supply each of the candidates with a penny-piece of the new bronze coinage.

GEOMETRICAL DRAWING.

THREE HOURS ALLOWED.

The constructions must be accurate, and show clearly, by plain and dotted lines, with appropriate letters of reference, the principles on which they are based. They may be put in ink, or left in pencil, at the discretion of the candidate, provided they are distinct.

No deviation from the conditions of the questions can be admitted; and since no candidate must answer more than two questions from any one section, he is advised not to attempt more than the time will admit of his completing, since little or no credit will be given for incompleted or inaccurate answers.

I.

1. Draw a circle of 1·5 inches radius; inscribe and circumscribe it with squares, having their sides parallel.
2. Draw a square of three inches side, divide it into 64 equal squares, put a light tint of Indian ink on thirty-two of them so as to form a chess board.
3. Draw sixteen equal circles of ·75 inches in diameter, their centres being in the intersections of four parallel lines, 1·5 inches apart, with four others at the same distance, and at right angles to them.
4. Draw a circle of two inches radius; divide its circumference into six equal arcs; describe an arc of a circle of two inches radius fron each point of division, stopping these arcs at the circumference of the first, and each arc passing through its centre.

N.B.—These questions are intended to test the candidate's neatness and accuracy.

II.

1. Draw in one figure two squares of one and two inches *area.*
2. Draw a semi-circle of 1·5 inches radius; determine a point in its circumference such that the chords drawn from it to the ends of the diameter shall be as 1 : $\sqrt{2}$.
3. Construct a rectangle of three inches area, and having its sides as 2 : 3.
4. Draw a regular pentagon of 1·5 inches side, and a square equal to it in area.
5. Construct a triangle having its sides as 2 : 3 : 4, but inscribed in a circle of 1·5 inches radius.
6. Draw a triangle, its sides being 2, 2·5, 3 inches; bisect this triangle:—
    1. By a line parallel to one side.
    2. By a line perpendicular to one side.

III.

1. Draw a circle of 1·5 inches radius: in it inscribe four equal circles, each touching two others.
2. Two circles of 2 and ·75 inches radii touch one another internally; draw a third circle of one inch radius to touch both, but not at the point of contact of the first two.
3. Draw an ellipse having its axes 3·5 and 2·5 inches, without using the foci.
4. Draw the curve line, every point of which is equidistant from a given straight line, and a point at one inch from that straight line.

IV.

1. The sides of a rectangle are three and two inches long; draw the *plan* of it when those sides are inclined to the paper 40° and 60°.
2. An equilateral triangle of two inches side has its three corners at 1, 2, and 2·5 inches above the paper. Draw its *plan.*
3. The plane of a square of two inches side is inclined at 50°, and the diagonal is inclined at 30°. Draw its *plan.*
4. Two diameters, containing an angle of 60°, of a circle of two inches radius, are inclined at equal angles of 35° to the plane of the paper. Draw the *plan* of the curve.

V.

A right pyramid, four inches high, has for its base a pentagon of 1·5 inches side. Draw a *plan* and *elevation* of the solid under the following conditions of position:—

1. When one *face* is horizontal.
2. When one *edge* is horizontal, and the plane of an adjacent face inclined to the paper at 26°.
3. When two faces are vertical.
4. When it is suspended freely from one corner of the base.
5. The solid is cut by a plane parallel to one face, and at ·3 inch from it. Draw the form of the section.
6. Show the *developed* surface of the frustum.

VI.

1. A right cone, four inches high, with a circular base of 1·5 inches radius, stands on the paper; it is touched by three equal spheres, each of which touches the other two. Show a plan of the whole.
2. Two equal triangular pyramids, all the faces of which are equilateral triangles of 2·5 inches side, are placed with two faces in contact, so that the edges of one are opposite the centre line of the faces of the other pyramid; all these faces being supposed produced, determine the mutual intersection of the two, and draw a plan and elevation of them.
3. The axes of two equal cylinders, 3·5 inches long and 3·5 inches in diameter, meet at right angles in their centres. Show the two solids penetrating each other in isometrical projection.
4. A square of two inches side is parallel to the plane of projection (the picture). Determine its distance from that plane when its perspective projection is a square of equal area, half its area, or double its area, the distance of the eye being five inches.

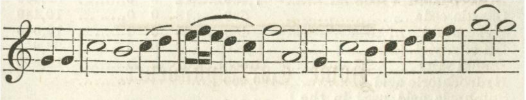
MUSIC.

THREE HOURS ALLOWED.

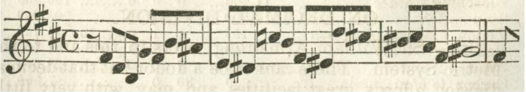
I. Rudiments of Musical Grammar.

(The answers to Nos. 1 to 4 must be written on music-paper.)

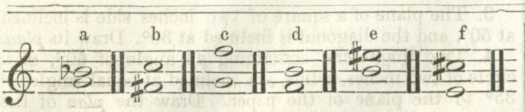
1. Give an example of every kind of time with which you are acquainted, and write over each example *what* kind (simple, common, or other) it is in.
2. Write the following passage in $\frac{2}{4}$ time.



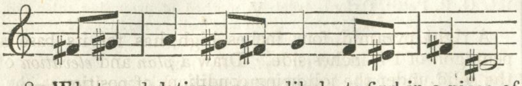
3. Transpose the following into *Do* (C) minor.



4. Write the signatures of *Fa* (F), *Sol* (G), and *La* ♭ (A ♭) *major;* and of *Re* (D), *Mi* (E), and *Fa* (F) *minor.*
5. Explain what is meant by the inversion of an interval, and state what change (of quality) each diatonic interval undergoes on inversion.
6. Name the intervals formed by the following, specifying the quality (major, perfect, or other) of each:—



7. In what scale, or key, is the following:—

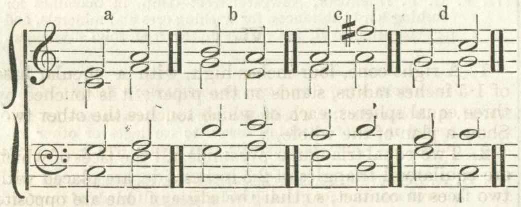


8. What modulations are we likely to find in a piece of music in the scale, or key, of *Re* (D)?

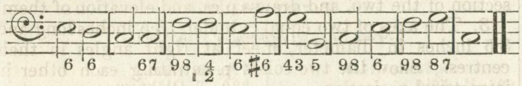
II. HARMONY, COUNTERPOINT, AND MUSICAL HISTORY.

(The answers to Nos. 1, 2, and 3, must be written on music paper.)

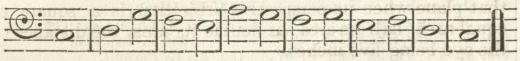
1. Correct the errors in the following with as little alteration of the parts as possible:—



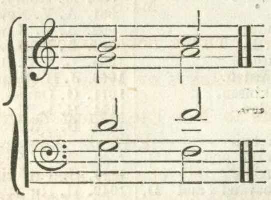
2. Add three parts to the following figured bass:—



3. Add a part, or parts, in any species of counterpoint, above or below the following:—



4. What is there exceptional, or objectionable, in the following progression:—



5. In what countries were the following composers born, and in what centuries did they flourish:—Arne, J. S. Bach, Croft, Orlando Gibbons, Haydn, Josquin des Près, Mozart, Palestrina, Purcell, Rossini, Tallis.

Home Correspondence.

◆

ON DECIMAL DIVISION.

SIR,—Sir William Armstrong refers to this and to the Metric System. There cannot be a doubt but that decimal division affords great facilities, and may, with very little alteration, be applied in this country without adopting the French method.

Sir William refers to the decimal of an inch, but that does not afford the extent of the facilities which the decimal of a foot will give. Had Mr. Penrose not used the decimal of a foot in taking the measures of the Parthenon, and indeed Professor Greaves, in 1637–38, in taking the measures within the Great Pyramid, their exact geometrical proportions could not have been discovered. The decimal of a foot is, therefore, all that is required to facilitate calculations wherever the standard English foot is used. This will afford facilities for determining measures of length, surface, or capacity, both beyond and below the foot, to the greatest extent and the minutest expression that can be required. All this those who have used the decimal of an inch will easily comprehend; and children may be taught with great facility to understand and apply it.

Then the only alteration required to reduce all cash accounts to decimals, is the division of the English shilling into ten. All accounts may then be expressed in pounds and the decimal parts of a pound sterling, and every coin in circulation, to which may be added, if thought necessary, coins to represent the decimal parts of the tenth of a shilling.

In this way, with the least possible alteration, measures of capacity and weight, for commercial purposes of magnitude requiring facility and constant calculations, may as readily be made decimal.

These, it is submitted, may be quite sufficient for a first experimental step; and as these become familiar, and the way appears clear, if necessary, the decimal system may be applied to chemical weights and measures; but there would be great danger to legislate on that at present.

The decimal division of a circle would be attended with great disadvantages. The number of divisions representing a chord equal to the radius cannot thus be expressed, and there are many other objections to such a division of a circle.

For all those who may require to express accounts of any kind—English in French, or French in English—the decimal system will afford much facility.

JOSEPH JOPLING.

6, Vassall-terrace, Kensington, London, W.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, September 4th*, 1863.]

Dated 22nd August, 1863.

2086. R. A. Brooman, 166, Fleet-street—A new metallic alloy. (A com.)
2087. L. E. C. Martin, 32, Albion-street, Hyde-park—Imp. in apparatus for heating and purifying water.
2088. S. Moore, Liverpool-street, Bishopsgate-street—Imp. in the means of and apparatus for electro-plating, said apparatus being also applicable to medical purposes.
2090. W. Benson and P. W. Greenwood, Leeds—Imp. in preparing and spinning wool and other similar fibres.

Dated 24th August, 1863.

2092. A. Jobson, Darlington, Durham—Imp. in machinery for drawing or discharging coke ovens and loading coke waggons.
2094. C. S. Grasset, Larnoca, Cyprus, Turkey—An improved double Mac-Carty gin or machinery used for cleaning cotton from its seeds.
2095. A. Capello, 4, Rue du Repentir, Marseilles—An improved method of and apparatus for glazing morocco leather.
2097. H. F. McKillop, R.N., Belvedere, Kent—Imp. in cleansing ships' bottoms.
2098. R. A. Brooman, 166, Fleet-street—Imp. in air and gas engines (A com.)

Dated 25th August, 1863.

2100. G. E. Lewis, H. Walker, and J. B. Wayne, Birmingham—Imp in breech-loading fire-arms.

Dated 26th August, 1863.

2104. T. Hopkins, jun., White Hart-place, Kennington-cross—Imp. in carriage door handles.
2105. J. Taylor, Gomersall, Yorkshire—Imp. in the manufacture of soap. (A com.)
2108. T. Westhorp, Falcon Works, Bromley—Imp. in machinery or apparatus for preparing cut rope strands or yarn for carding into oakum.
2109. R. Johnson and G. Bedson, Manchester—Imp. in pointing wire rods or wire, in order to facilitate their introduction into draw plates.

2110. W. E. Newton, 66, Chancery-lane—Improved apparatus for extracting coal ores or other minerals or substances from mines, which apparatus may be also employed for raising and lowering the workmen and their tools or implements. (A com.)

2111. J. Platt and W. Richardson, Oldham, Lancashire—Imp. in stoves or grates.

2112. J. Fry, Chesham, Buckinghamshire—Imp. in mashing machinery used in making fermented liquors.

2113. D. Blake, Manchester—Imp. in shaping and punching metallic articles, and in the machinery or apparatus to be employed therein. (A com.)

2114. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in obtaining and applying motive power. (A com.)

[*From Gazette, September* 11*th*, 1863.]

Dated 27*th June*, 1863.

1615. G. Clark, 30, Craven-street, Strand, Westminster—Imp. in the construction of guns and projectiles, and of carriages, platforms, and shields for working and protecting guns.

Dated 22*nd July*, 1863.

1834. C. Senior, Dead Waters, near Huddersfield—Imp. in means or apparatus for closing, punching, and rivetting hose pipes of leather or other substances, applicable also for punching and riveting mill bands or driving straps, and similar purposes.

Dated 28*th July*, 1863.

1870. M. Cockerell, 3, Munden-terrace, Hammersmith—The imp. of mortice and other door locks and latches.

Dated 6*th August*, 1863.

1937. J. E. Dowson, 4, Victoria-street, Westminster—A new application of rolled metal plates to the formation of roadways, bridges, tramways, and other structures.

1943. W. Clark, 53, Chancery-lane—Imp. in taps or stopcock apparatus. (A com.)

Dated 10*th August*, 1863.

1967. J. A. Fullerton, Manchester—Imp. in the method of fastening hoops for packing bales, and in the machinery or apparatus employed therein.

Dated 17*th August*, 1863.

2038. H. A. Bonneville, 38, Porchester-terrace, Bayswater—Imp. in engraving. (A com.)

Dated 18*th August*, 1863.

2044. J. Broadley, Saltaire, near Bradford—Imp. in means or apparatus employed in weaving.

Dated 21*st August*, 1863.

2077. R. Thompson, New Charlton, Kent—Imp. in machinery for planing curved, curvilinear, irregular, and other forms in iron, steel, and other metals.

2082. J. B. C. Lange, Paris—An improved apparatus for indicating or registering the speed or distance travelled by vehicles, carriages, and such like, which said apparatus is also applicable to engines, water-wheels, and prime motors of any description.

Dated 25*th August*, 1863.

2099. A. Hett and F. W. Basset, Camberwell—Imp. in preserving animal substances, and animal and other substances used for food.

Dated 26*th August*, 1863.

2106. J. L. Kessler, Paris—Imp. in apparatus for evaporating and distilling.

2107. S. Fattorini, 3, Rue Joubert, Paris—A new division of time, and the application thereof to mathematical and other instruments.

Dated 27*th August*, 1863.

2118. J. Ward, Liverpool—Imp. in diving apparatus.

2120. W. E. Newton, 66, Chancery-lane—Imp. in breech-loading fire-arms. (A com.)

Dated 28*th August*, 1863.

2122. G. Davies, 1, Serle-street, Lincoln's-inn—Imp. in the manufacture of iron and steel from the cinders and refuse of puddling and other furnaces, and from certain kinds of ores. (A com.)

2124. J. Shaw, New Wortley, Leeds—Imp. in machines for cutting or reducing turnips or other roots as food for animals.

2126. E. Amourous, 4, South-street, Finsbury—Imp. in apparatus for separating solid from fluid fecal matters.

2128. J. Alison, Reigate—Imp. in apparatus for tilling land, which improvements are chiefly applicable when steam power is employed.

2130. J. Walls, Farington, near Preston—Imp. in steam boilers, and in apparatus connected therewith.

Dated 29*th August*, 1863.

2134. T. Williams, Manchester—Imp. in machinery or apparatus for crushing and flattening the stalks of tobacco and other substances.

2138. D. Speirs, A. Boyd, and J. Kirkwood, Paisley—Imp. in looms for weaving.

2140. F. C. P. Hoffmann, Newgate-street—Imp. in shears for cutting metal and other substances.

2142. A. Rowand, Glasgow—Imp. in evaporating fluid solutions, and in the machinery, apparatus, or means employed therein.

2144. L. E. C. Martin, 32, Albion-street, Hyde-park—Imp. in apparatus for generating steam, and for generating gases to be used for heating steam boilers, and for other purposes.

Dated 31*st August*, 1863.

2146. H. E. Kramer, Leipsic, Saxony—Imp. in printing in colours pictures or devices to be used in ornamenting porcelain, stoneware, earthenware, or any other substances where the colours can be annealed or melted or burnt in.

2150. W. E. Gedge, 11, Wellington-street, Strand—An improved watch. (A com.)

2154. G. B. Pettit, Oxford-street—A method of preparing mica and talc, in order to render them applicable to articles of wearing apparel, and to ornamental purposes.

Dated 1*st September*, 1863.

2162. G. T. Bousfield, Loughborough-park, Brixton—Imp. in the manufacture of illuminating gas. (A com.)

2164. G. W. Ewens, Sherborne-lodge, Dorris-street East, Kennington Cross—Imp. in the manufacture of wadding paper and felted fabrics, and in the preparation of vegetable fibres to be used in such manufactures.

Dated 2*nd September*, 1863.

2166. J. Lewis, Manchester—Certain imp. in machinery or apparatus for preparing and drying clay, and also in machinery to be employed in the manufacture of bricks and tiles.

2170. C. H. Corlett, Gustrow, Mecklenburg-Schwerin—Imp. in valves, taps, or cocks.

2172. F. C. P. Hoffmann, Newgate street—Imp. in machines for crushing hard substances, for washing ores and minerals, and for separating earth and earthy matter from solid substances.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2179. H. A. Bonneville, 38, Porchester-terrace, Bayswater—An improved mode of attaching horses to carriages or other vehicles, and apparatus therefor. (A com.)—3rd September, 1863.

2180. H. A. Bonneville, 38, Porchester-terrace, Bayswater—An improved machine for glossing and glazing all kinds of threads. (A com.)—3rd September, 1863.

PATENTS SEALED.

[*From Gazette, September* 11*th*, 1863.]

September 11*th*.

608. P. Adie.
663. J. Cassell.
665. W. R. Mulley.
666. H. Wilson.
672. J. Renshaw.
673. W. Rossetter.
674. F. Buser-Kraushaar.
675. H. D. Taylor and J. W. Taylor.
679. J. Polkinghorne.
680. H. B. Barlow.
687. J. H. Johnson.
692. J. Page.
695. R. Alexander.
699. J. Walworth.
703. T. W. Willett.
709. W. G. Eavestaff.
712. W. H. Atkinson.
713. W. E. Gedge.
715. J. Cox.
719. W. Symington.
720. W. C. Wild and J. H. Randel.
721. W. Donbavand and D. Crichton.
723. R. A. Brooman.
724. F. Richmond, H. Chandler, and J. G. Richmond.
727. B. Wren.
729. T. Oldknow.
737. H. O. Haughton.
751. J. Brigham and R. Bickerton.
767. W. Clark.
773. A. Topham, J. Topham, and J. Topham.
790. M. L. Parnell.
807. J. King and T.H. Marshall.
832. H. Hamer.
833. J. M. Dunlop.
838. M. Henry.
881. A. V. Newton.
902. A. V. Newton.
904. A. V. Newton.
1035. L. A. J. Bruet.
1066. J. H. Johnson.
1071. G. Davies.
1194. H. L. Emery.
1376. D. Wilson and E. A. Cowper.
1424. W. E. Newton.
1574. C. T. Burgess.
1642. H. Hutchinson.
1690. G. P. Reed.
1702. W. E. Newton.
1726. R. Hornsby, jun., J. Bonnall, and W. Astbury.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, September* 15*th*, 1863.]

9*th September*.

2184. T. Thornton, E. Thornton, and J. Thornton.
2193. R. C. Clapham.
2209. N. Thompson, jun.

10*th September*.

2202. F. A. N. Freppel.
2233. R. Mushet.

11*th September*.

2207. J. Wright.
2210. A. Ransford.
2247. J. M. Napier.
2280. M. Sautter.
2344. T. Brookes and T. Adams.

12*th September*.

2205. R. H. Gratrix and M. P. Javal.
2225. J. Petrie.

PATENT ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[*From Gazette, September* 15*th*, 1863.]

7*th September*.

2126. J. Milnes & W. Thompson.

8*th September*.

2149. C. Hill.

9*th September*.

2113. J. Taylor.

11*th September*.

2142. E. Green.